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OPD - 1995-03-29

TI - IMAGE INFORMATION RETRIEVAL DEVICE

IN - SASAKI YASUO

PA - OLYMPUS OPTICAL CO

IC - G06E3/00 ; G06F17/14



TI - Image information retrieval appts for searching specific image pattern - combines correlation of each degree at which phase shift is passed and searches for difference in angle from amount of phase shift and correlating synthesis result

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PA - (OLYU ) OLYMPUS OPTICAL CO LTD

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AB - J08272473 The appts searches for a specific image information from an image. The coherent light from a light source (1) is irradiated on the free space of an optical modulator ( 2) and displays an image. The Fourier conversion of transparent light is performed by a first lens ( 3). A matched filter (4 ) has a Fourier transformation function for a number of symmetrical components in which the degree of search differs. A second lens ( 5) performs reverse Fourier conversion of the light which penetrates the matched filter.

- A phase shift appts passes the phase shift which differs with each correlation degree. The optical system which comprises a third lens ( 7), a filter (8) and a fourth lens (9) combines the correlation of each degree at which phase shift is passed, and displays it on an output surface ( 10). An analysis appts searches for difference in angle from the amount of phase shift and correlating synthesis result.
- ADVANTAGE - Searches image information satisfactorily at high speed even when search object exhibits rotation slippage. Enables quick processing by avoiding rotation of search object.
- (Dwg. 1/3)

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IN - SASAKI YASUO

PA - OLYMPUS OPTICAL CO LTD

TI - IMAGE INFORMATION RETRIEVAL DEVICE

AB - PURPOSE: To provide an image information retrieval device which can improve and fast and effectively retrieve the revolving slippage of a retrieving object.

- CONSTITUTION: A space optical modulator 2 showing an image is irradiated by the coherent light emitted from a light source 1, and the light transmitted through the modulator 2 undergoes the Fourier transformation through a lens 3 and irradiates a matched filter 4. The matched filter 4 includes the Fourier transformation of plural rotary symmetrical components of different degrees of a retrieving object. The light transmitted through the matched filter 4 undergoes the reverse Fourier transformation through a lens 5 and irradiates a linear phase modulator 6. Thus the different shifts are caused for every correlation between the rotary symmetrical component of every degree and the

[Claim 1] Image information reference equipment characterized by providing the following The space optical modulator which displays a picture The coherent light source for projecting the picture The lens which carries out the Fourier transform of the projected light The Fourier transform of two or more symmetry-of-revolution components from which the degree for reference differs is included. to each of this Fourier transform The filter by which the term which shifts the position of correlation of each degree is multiplying so that correlation may not lap mutually in the correlation screen, The lens which carries out the inverse Fourier transform of the light which penetrated the filter, and the phase shift equipment which gives a phase shift which is different in correlation of each degree and into which the amount of phase shifts is continuously changeable, The optical system which compounds correlation of each degree to which the phase shift was given, picture taking-in equipment which incorporates the synthetic result of the correlation corresponding to the various amounts of phase shifts, and analysis equipment which shifts [ result / correlation composition / the amount of phase shifts, and ] from the position for reference, and searches for an angle

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the image information reference equipment with which specific image information (picture pattern) is searched out of a picture.

[0002]

[Description of the Prior Art] The specific image information (picture pattern) expressed with f (x y) out of the picture expressed with g (x y) can be looked for by the following methods. First, the correlation of g (x y) and f (x y) is defined as follows.

[0003]

Equation 1]

$$[g\&f](\xi,\eta)=\iint dxdy\,[g(x,y)\,f(x-\xi,y-\eta)]$$

Integration ranges are all flat surfaces here. If it is g(x y) =f (x-d1 and y-d2), since [g&f] (xi, eta) has a sharp peak by = (xi, eta) (d1 and d2), it turns out that the picture pattern for [ f (x y) ] reference is in the position of (d1 and d2). Next, how to obtain g&f optically is described. When the Fourier transform of G and f is set to F, g&f can express the Fourier transform of g with the following formula.

[0004]

Equation 2]

$$[g\&f](\xi,\eta)=\mathcal{F}^{-1}[G(k)\,F(-k)]$$

ここに、$k$は波数ベクトル、$\mathcal{F}^{-1}$は逆フーリエ変換である。

The Fourier transform is easily realizable optically by letting a lens pass as known well. light with the spatial distribution of g (x y) -- focal distance f0 only -- opening -- a lens -- through -- further -- focal distance f0 If it observes in the distant place, G (k1 x/f0 and k2 y/f0) will be obtained. Here, it is k1. A wave number vector is k2 similarly x components. It is the y component. Product GF is

light which penetrated the filter, and the phase shift equipment which gives a phase shift which is different in correlation of each degree and into which the amount of phase shifts is continuously changeable, It has the optical system which compounds correlation of each degree to which the phase shift was given, the picture taking-in equipment which incorporates the synthetic result of the correlation corresponding to the various amounts of phase shifts, and analysis equipment which shifts [ result / correlation composition / the amount of phase shifts, and ] from the position for reference, and searches for an angle.

[0010]

[Function] First, the amount of phase shifts is continuously changed with phase shift equipment, the luminescent spot which appears in a correlation composition side is found, and it asks for the position. Next, the amount of phase shifts which takes maximum is investigated, and it asks for the angle of the rotation gap for reference based on this. Thus, the position for reference and the angle of a rotation gap are known.

[0011]

[Example] The example of this invention is explained using a drawing. First, the image information reference equipment of the first example is explained, referring to drawing 1 and drawing 2 . As shown in drawing 1 , the coherent light injected from the light source 1 is irradiated by the space optical modulator 2 as which the picture is displayed. The Fourier transform of the light which penetrated the space light modulation 2 is carried out with a lens 3, and it is irradiated by the matched filter 4. The matched filter 4 includes the Fourier transform of two or more symmetry-of-revolution components from which the degree for reference differs. Moreover, the matched filter 4 has the function to make it the symmetry-of-revolution component of each degree and correlation of a picture not lap mutually on the field of the linear-phase modulator 6 mentioned later. This is realized by multiplying the Fourier transform of the n-th symmetry-of-revolution component by exp (inch (d1 x+d2 y)).

[0012] The inverse Fourier transform of the light, i.e., the light of the product of the Fourier transform of a picture and the Fourier transform of a symmetry-of-revolution component symmetrical with reference, which penetrated the matched filter 4 is carried out with a lens 5, and it is irradiated by the linear-phase modulator 6. The correlation with the symmetry-of-revolution component of each degree and a picture is projected on a different position by the reason mentioned above on the field of the linear-phase modulator 6. The linear-phase modulator 6 gives a different phase shift to each of correlation with the symmetry-of-revolution component of each degree, and a picture.

[0013] When the number of the correlation projected on the field of the linear-phase modulator 6 is decided as a linear-phase modulator 6, as shown in drawing 2 (A), it is good also as composition which arranges the phase modulators 13a-13c independent of the projection position of each correlation, and controls these phase modulators independently.

[0014] Moreover, when the correlation projected on the field of the linear-phase modulator 6 is located in a line in the shape of a straight line, as shown in drawing 2 (B), it is good also as composition which supports strangely possible [ an inclination ] the trapezoid slightly prism 14 which gives alignment phase contrast in the direction of a list with a swinging arm 15, and changes the degree phi of tilt angle for this by the piezo drive 16. Or it is good also as composition which voltage is impressed [ composition ] to the electrode 18 prepared in the opposed face [ **** / un-] with a signal generator 19 to the trapezoid slightly electro-optics medium 17 ground so that it might have the difference in the alignment optical path length in the direction of a list as shown in drawing 2 (C), generates the electric field which have an alignment inclination in the direction of a list, produces refractive-index change, and produces phase contrast change. In this case, it is

storage 36. Analysis equipment 37 takes a mutually related prolonged average, investigates the position of the luminescent spot, and decides the target position. Next, only the point corresponding to the luminescent spot is opened by the space optical modulator 32 which receives the light divided by the beam splitter 33, and the intensity of the point is investigated by the back photodetector 31. In the lock-in amplifier 35 which inputs the light divided by the beam splitter 24 as a reference beam, the rotation gap angle alpha is searched for by investigating the difference of the phase of the beat of a reference beam, and the phase of the beat of a correlation result.
[0023] Since phase compensation of two or more symmetry-of-revolution components for reference is carried out and they are added together, it excels in discrimination nature, and since the reference symmetry is not rotated further, the image information reference equipment of this example can also be processed at high speed.
[0024] As mentioned above, although the example was given and this invention was explained, this invention is not limited to the upper example. this invention includes the following invention.
[0025] 1.
The space optical modulator which displays a picture, and the coherent light source for projecting the picture, (Composition) The Fourier transform of two or more symmetry-of-revolution components for which the degree for reference differs from the lens which carries out the Fourier transform of the projected light is included. to each of this Fourier transform The filter by which the term which shifts the position of correlation of each degree is multiplying so that correlation may not lap mutually in the correlation screen, The lens which carries out the inverse Fourier transform of the light which penetrated the filter, and the phase shift equipment which gives a phase shift which is different in correlation of each degree and into which the amount of phase shifts is continuously changeable, Image information reference equipment equipped with the optical system which compounds correlation of each degree to which the phase shift was given, the picture taking-in equipment which incorporates the synthetic result of the correlation corresponding to the various amounts of phase shifts, and the analysis equipment which shifts [ result / correlation composition / the amount of phase shifts, and ] from the position for reference, and searches for an angle.
(An operation, effect) First, the amount of phase shifts is continuously changed with phase shift equipment, the luminescent spot which appears in a correlation composition side is found, and it asks for the position. Next, the amount of phase shifts which takes maximum is investigated, and it asks for the angle of the rotation gap for reference based on this. Thus, the position for reference and the angle of a rotation gap are known. Since phase compensation of two or more symmetry-of-revolution components for reference is carried out and they are added together, discrimination nature is good. Moreover, since the candidate for reference is not rotated, processing is quick.
[0026] 2.
(Composition) It is image information reference equipment with which the filter of the Fourier transform of two or more symmetry-of-revolution components arranges the correlation corresponding to each degree in in the shape of a straight line at equal intervals in the 1st term, and phase shift equipment gives an alignment phase change in the direction.
(An operation, effect) Since the flexibility of phase compensation is limited to the phase shift at the time of causing a rotation gap, there is no need for control of two or more shifters.
[0027] 3.
A means to display two or more symmetry-of-revolution components from which a picture and the degree for reference differ on the position with which it does not lap mutually, (Composition) The coherent light source for projecting a picture and two or more components for rotation, and the lens which carries out the Fourier transform of the projected light, The nonlinear medium arranged in the Fourier side of a lens, and a means to irradiate the projected light and the light in which it

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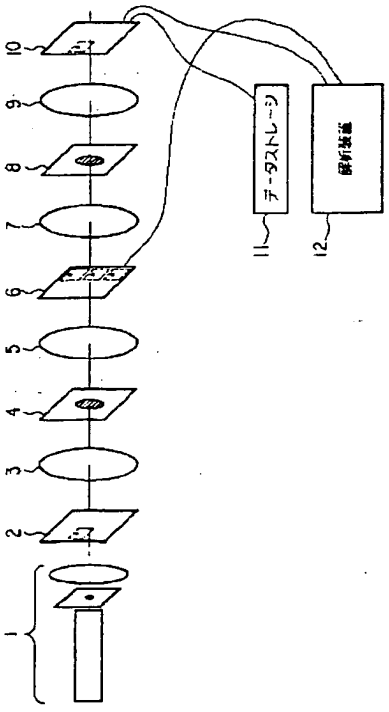
(71)出願人　000000376
オリンパス光学工業株式会社
東京都渋谷区幡ヶ谷２丁目43番２号

(72)発明者　佐々木　靖夫
東京都渋谷区幡ヶ谷２丁目43番２号　オリンパス光学工業株式会社内

(74)代理人　弁理士　鈴江　武彦

(54)【発明の名称】　画像情報検索装置

(57)【要約】
【目的】検索対象が回転ずれを起こしていても、これを良好にしかも高速で検索する画像情報検索装置を提供する。
【構成】光源１からのコヒーレント光は画像を表示した空間光変調器２に照射され、その透過光はレンズ３でフーリエ変換され、マッチドフィルタ４に照射される。マッチドフィルタ４は検索対象の次数の異なる複数の回転対称成分のフーリエ変換を含んでいる。マッチドフィルタ４を透過した光はレンズ５で逆フーリエ変換され、線形位相変調器６に照射され、各次数の回転対称成分と画像との相関の各々に異なる位相シフトが与えられる。これらの相関は、レンズ７とフィルタ８とレンズ９からなる光学系により合成され、出力面１０に表示される。出力面１０において、輝点の有無により検索対象の存在が分かり、輝点の位置から検索対象の位置が分かり、最大値となる位相シフト量から回転ずれ角が分かる。



ョンが得られる。これはジョイントトランスフォームコリレータ（ＪＴＣ）という。ＪＴＣにおいて、ｆ（ｘ，ｙ）を回転させながらコリレーションを見ると、ｇ（ｘ，ｙ）中の対象の回転ずれに伴なう回転角で輝点から見られる。

【０００８】

【発明が解決しようとする課題】検索対象の回転対称成分のコリレーションをとる方法は、弁別性が悪い。ＪＴＣを用いた方法では、検索対象を回転させる必要があるため、高速処理が難しい。本発明は、検索対象を、それが回転ずれを起こしていても、良好にしかも高速で検索する画像情報検索装置を提供することを目的とする。

【０００９】

【課題を解決するための手段】本発明の画像情報検索装置は、画像を表示する空間光変調器と、その画像を投影するためのコヒーレント光源と、投影された光をフーリエ変換するレンズと、検索対象の次数の異なる複数の回転対称成分のフーリエ変換を含み、該フーリエ変換の各々には、相関表示面において相関が互いに重ならないように、各次数の相関の位置をずらす項がかけ算されているフィルタと、フィルタを透過した光を逆フーリエ変換するレンズと、各次数の相関に異なる位相シフトを与える、その位相シフト量を連続的に変えられる位相シフト装置と、位相シフトの与えられた各次数の相関を合成する光学系と、様々な位相シフト量に対応する相関の合成結果を取り込む画像取込装置と、位相シフト量と相関合成結果から検索対象の位置とずれ角を求める解析装置とを備えている。

【００１０】

【作用】まず、位相シフト装置で位相シフト量を連続的に変えて、相関合成面に現れる輝点を見つけ、その位置を求める。次に、最大値をとる位相シフト量を調べ、これに基づき検索対象の回転ずれの角度を求める。このようにして、検索対象の位置と回転ずれの角度がわかる。

【００１１】

【実施例】本発明の実施例について図面を用いて説明する。まず、第一実施例の画像情報検索装置について、図１と図２を参照しながら説明する。図１に示すように、光源１から射出されたコヒーレント光は、画像の表示してある空間光変調器２に照射される。空間光変調２を透過した光は、レンズ３でフーリエ変換され、マッチドフィルタ４に照射される。マッチドフィルタ４は、検索対象の次数の異なる複数の回転対称成分のフーリエ変換を含んでいる。また、マッチドフィルタ４は、各次数の回転対称成分と画像の相関が、後述する線形位相変調器６の面上において互いに重ならないようにする機能を有している。これは、例えば、ｎ次の回転対称成分のフーリエ変換にｅｘｐ（ｉｎ（$d_1$ ｘ＋$d_2$ ｙ））をかけ算することで実現される。

【００１２】マッチドフィルタ４を透過した光すなわち



画像のフーリエ変換と検索対称の回転対称成分のフーリエ変換の積の光は、レンズ５により逆フーリエ変換され、線形位相変調器６に照射される。線形位相変調器６の面上においては、前述した理由により、各次数の回転対称成分と画像との相関は異なる位置に投影される。線形位相変調器６は、各次数の回転対称成分と画像との相関の各々に、異なる位相シフトを与える。

【００１３】線形位相変調器６としては、線形位相変調器６の面上に投影される相関の数が決まっている場合には、図２（Ａ）に示すように、各相関の投影位置に独立な位相変調器１３ａ～１３ｃを配置し、これらの位相変調器を独立に制御する構成としてもよい。

【００１４】また、線形位相変調器６の面上に投影される相関が一直線状に並ぶ場合には、図２（Ｂ）に示すように、その並び方向に線形な位相差を与えるわずかに台形なプリズム１４を揺動アーム１５により傾斜可変に支持し、これをピエゾドライブ１６により傾斜角度φを変える構成としてもよい。あるいは、図２（Ｃ）に示すように、並び方向に線形な光路長の違いを持つように研磨したわずかに台形な電気光学媒質１７に対し、非平行な対向面に設けた電極１８に信号発生器１９により電圧を印加して、並び方向に線形な傾きを持つ電場を発生させて屈折率変化を生じさせて位相差変化を生じさせる構成としてもよい。この場合、電気光学媒質の傾斜面には補償プリズム２０を設けることが好ましい。

【００１５】線形位相変調器６により位相シフトされた複数の相関（各次数の回転対称成分と画像のコリレーション）は、それ以降の光学系により合成される。位置を例えばｄずらす操作は、フーリエ面でｅｘｐ（ｉｋｄ）で表されるグレーティングをかけ算することに対応する。そこで、各相関のずらし量に対応するグレーティングの和のフィルタ８を配置し、その前後にレンズ７とレンズ９を配置することで、出力面１０（例えばＣＣＤ）に相関の合成が得られる。

【００１６】位相シフト量は線形位相変調器６で連続的に変えられ、様々な位相シフト量に対応する出力面上での合成結果はデータストレージ１１に取り込まれる。解析装置１２は、輝点の現れる位置を探し、その輝点が最大値をとる位相シフト量を調べる。この最大値をとる位相シフト量に基づいてき検索対象の回転ずれ角を求める。すなわち、輝点の有無により検索対象の存在が分かり、輝点の位置から検索対象の位置が分かり、最大値となる位相シフト量から回転ずれ角が分かる。

【００１７】このように本実施例の画像情報検索装置は、検索対象の複数の回転対称成分を位相補償して合算しているので弁別性が良い。また、検索対称を回転させないので、検索処理が高速で行なえる。

【００１８】続いて、第二実施例の画像情報検索装置について、図３を用いて説明する。図３に示すように、光源２１から射出されたコヒーレントな光は、ＡＯ変調器

【0028】4.
（構成）画像を表示する空間光変調器と、周波数の異なる複数のコヒーレント光を含むコリニアーな光を空間光変調器に照射する手段と、空間光変調器からの光をフーリエ変換するレンズと、各周波数の光に対応した、検索対象の次数の異なる複数の回転対称成分のフーリエ変換を含んでいるフィルタと、フィルタを透過した光を逆フーリエ変換するレンズと、各点において複数の周波数間で発生するうなりの位相とピーク値から検索対象の位置とずれ角を求める解析装置とを備えている、画像情報検索装置。
（作用、効果）うなりのピーク値、または振幅の大きい点の位置を探し、その点について、うなりの位相の入力光のうなりとの差を測定する。この位置から対象の位置がわかり、位相から回転ずれ角がわかる。複数の回転対称成分を、位相補償して合算するので弁別性がよい。可動部が全くないので検索処理が高速で行なえる。

【0029】
【発明の効果】本発明の画像情報検索装置は、検索対象の複数の回転対称成分を位相補償して合算しているので弁別性に優れ、検索対象を回転させないので処理が速い。つまり、回転ずれを起こしている検索対象をも良好に高速で検索できる画像情報検索装置が得られる。
【図面の簡単な説明】
【図1】本発明の第一実施例の画像情報検索装置の構成を示す図である。
【図2】図1の線形位相変調器の具体的な構成を三種類示す図である。
【図3】本発明の第二実施例の画像情報検索装置の構成を示す図である。
【符号の説明】
1…光源、2…空間光変調器、3…レンズ、4…マッチドフィルタ、5…レンズ、6…線形位相変調器、7…レンズ、8…フィルタ、9…レンズ、12…解析装置。

【図1】